AMENDMENTS TO THE DRAWINGS

Please replace Fig. 1 with the attached Replacement Figure in which labels are added for the pump protection line, the maximum efficiency line and the rotational speed lines.

Attachment:

1 Replacement Sheet

REMARKS

Claims 1-6 are all the claims pending in the application. By this Amendment, Applicant amends claim 1. No new matter is added. Support for the amendment is found, *e.g.*, at pages 2-3 of the specification as filed. Reconsideration and allowance of claims 1-6 are respectfully requested in view of the following remarks.

I. Preliminary Matters

Applicant thanks the Examiner for accepting the drawings filed on February 13, 2008[1] and for initialing the references listed on Form PTO/SB/08 submitted with the Information Disclosure Statement filed on February 13, 2008.

II. Rejections under 35 U.S.C. § 112, first paragraph

The Examiner rejected claims 1-6 under 36 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. Applicant respectfully traverses this rejection.

Specifically, the Examiner contends that the disclosure does not provide enablement for the following terms or teach how to perform the steps of

- running the rotational speeds of the running compressor assemblies in a fixed rotational speed ratio with respect to characteristic-map data filed for each compressor assembly
- an equal percentage throughflow quantity adjustment
- the determination of "optimum" values

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[1] Applicant notes that the Examiner specifically refers to the drawings filed on February 13, 2008. As a result, FIG. 1 still needs to be accepted. However, since Applicant files a replacement sheet with this amendment, replacing FIG. 1, Applicant respectfully requests that the Examiner accepts the new drawing of FIG. 1.

- the process of performing a reciprocal mutually coordinated variation of the rotational speed desired values.

See pages 2 and 3 of the Office Action. In addition, the Examiner contends that it is unclear what specific characteristic map is being referred to and how the operating points lead to the allegedly non-illustrated efficiency lines. *See* page 3 of the Office Action.

1. Characteristic Maps and Surge Protection

Natural-gas compressor stations are operated by a plurality of compressor assemblies. Such compressor assemblies often differ from each other in design and in particular in different rotors. *See* paragraph [004] of the specification as filed. As a result, different compressor assemblies have different characteristic maps. However, the elements of a characteristic map and its use are always similar.

It is generally known in the art that characteristic maps describe multiple dependencies of certain parameters or variables that represent a state of operation of a compressor assembly. For example, one of ordinary skill in the art knows that characteristic maps generally comprise lines of the same rotational speed, such as for example, a line of a rotational speed of 3850 rotations per minute, as depicted in FIG. 1.[2] It is also known that one axis of a characteristic map describes the flow ("Operational Volume") through the respective compressor assembly and that another axis of the characteristic map relates to certain pressures or a pressure relation ("Isentropic Displacement Height").

[2] FIG. 2B refers to such a rotational speed of 3850 1/min as a set point value for compressor assemblies 1 and 3.

Accordingly, one of ordinary skill in the art knows that by varying the rotational speed and keeping the isentropic displacement height at the same value, the operational volume, or throughflow, through the compressor assembly will vary.

In addition, it is also well known in the related art that a compressor needs to be protected from surge. *See* European Patent Application 0 769 642 (hereinafter " '642 Application") at page 2, lines 16-17[3]. A surge protection control system is described, for example, in Dresser-Rand "Surge Control" (hereinafter "Dresser", copy enclosed).

> Centrifugal and axial compressors will surge when **forward flow through the compressor can no longer be maintained, due to an increase in pressure** across the compressor, and a momentary flow reversal occurs. Once surge occurs, the reversal of flow reduces the discharge pressure or increases the suction pressure, thus allowing forward flow to resume again until the pressure rise again reaches the search point. This surge cycle will continue until some change is made in the process or compressor conditions. A surge controller typically measures a function of pressure rise versus flow. The controller **operates a surge valve** to maintain sufficient forward flow **to prevent surge** (emphasis added).

See Dresser at page 1 of 4. In other words, if the pressure ("Isentropic Displacement Height") increases for a given rotational speed, the flow ("Operational Volume") through the compressor decreases. In FIG. 1, a certain operating point located on a certain rotational speed line would move on the respective rotational speed line towards the pump protection line (*see* FIG. 1) on the left side of the characteristic map, given that the rotational speed remains constant and the

[3] Applicant notes that European Patent Application 0 769 642 has been incorporated by reference in the originally filed specification. *See* paragraph [005] of the specification as filed.

isentropic displacement height rises. A pump protection line is also known in the art as surge limit line. *See* FIG. 1 of the '642 Application. For a given constant rotational speed, a compressor assembly can be protected from turning to a surge or can be brought back to normal operation by opening surge prevention valves. *See* paragraph [016] of the specification as filed. A person of ordinary skill in the art knows that opening surge prevention valves increases forward flow ("Operational Volume") so that a certain operating point would move towards the right side of the characteristic map in the rotational speed line. *See* Dresser at page 1 of 4.

Further, it is well known in the art that a characteristic map may contain a maximum efficiency line. Such a maximum efficiency line is a specific control line, positioned to the right side of the pump protection line, as depicted in FIG. 1. An example of a maximum efficiency line can be found at page 29 of Keith LaMar Coleman, "Aeromechanical Control of High-Speed Axial Compressor Stall" (The Ohio State University 2006, copy enclosed).

2. Running the rotational speeds of the running compressor assemblies in a fixed rotational speed ratio with respect to characteristic-map data filed for each compressor assembly

The Examiner acknowledges that one of ordinary skill in the art understands what a fixed rotational speed ratio or what an operating point of a compressor within a characteristic map is. However, the Examiner contends that it is unclear what association a fixed rotational speed ratio has with respect to a characteristic map. *See* page 4 of the Office Action.

Applicant respectfully submits that from the above discussion of a characteristic map of a compressor assembly, it is clear that different compressor assemblies have different

characteristic maps. There can be different shapes of such a characteristic map, as well as different values of the respective parameters, described in such a characteristic map. Different shapes are depicted, for example, in FIG. 1 of Dieter Lau, "Kennfeldoptimierung fuer Erdgasverdichtereinheiten im Parallelbetrieb" ["Characteristics Optimization for Natural Gas Compressor Units in Parallel Operation'], 1993, Siemens AG[4].

As discussed above, one of ordinary skill in the art would know that a compressor assembly needs, *e.g.,* to be protected from surge. For which combination of parameters surge occurs depends from the characteristics described in the characteristic map of the respective compressor assembly. In other words, one of ordinary skill in the art would know that an operating point with respect to a rotational speed of a compressor assembly needs to be an operating point on the rotational speed line inside the boundaries of the specific characteristic map on the right side of the pump protection line.

Thus, a fixed rotational speed ratio with respect to characteristic-map data filed for each compressor assembly would be clearly understood by one skilled in the art in that the fixed rotational speed ratio needs to be determined by choosing rotational speed values of each compressor assembly that are inside the boundaries of the respective characteristic map.

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[4] The document has been filed in an Information Disclosure Statement on February 13, 2008.

3. Varying the rotational speed ratio by means of an equal-percentage adjustment of the operational volume of each of the running compressor assemblies and thereby adjusting the throughflow quantity of the natural-gas compression station via the rotational speed, until surge prevention valves of each of the running compressor assemblies of the natural-gas compression station are closed

The Examiner contends that it is unclear if "varying the rotational speed ratio by means of an equal percentage throughflow quantity adjustment," as recited in claim 1, is associated with the station or with each individual compressor. Specifically, the Examiner contends that it is unclear whether the equal percentage throughflow quantity adjustment relates to the station as a whole or to each of the individual compressor assemblies. *See* page 5 of the Office Action.

Applicant respectfully submits that for one skilled in the art it is clear that a variation of the rotational speed of a compressor assembly will lead to a change of the throughflow ("Operational Volume") of the respective compressor assembly. If, for example, a compressor assembly with a characteristic map, as depicted in FIG. 1, would be operated with a constant pressure ("Isentropic Displacement Height"), raising the rotational speed would result in a movement of the operating point parallel to the Operational Volume axis to the right.

The rotational speed ratio can be varied in a way that the percentage of the change in the throughflow quantity ("Operational Volume") of each compressor assembly is equal. Because such a variation can result in a surge of a particular compressor assembly, the rotational speed ratio is varied until surge prevention valves of the compressor assemblies are closed. *See* paragraph [016] of the specification as filed.

Again, as discussed above, one skilled in the art knows how surge prevention valves are used in order to control the flow ("Operational Volume") through a compressor assembly. Accordingly, it would have been clear for one skilled in the art that an equal percentage throughflow quantity adjustment means that the flow through each compressor assembly is adjusted in order to adjust the throughflow through the whole station.

However, in order to clarify what was already implicitly claimed in claim 1, Applicant has amended claim 1 to recite "thereafter varying the rotational speed ratio by means of an equal-percentage adjustment of an operational volume of each of the running compressor assemblies and thereby adjusting the throughflow quantity of the natural-gas compression station via the rotational speed, until surge prevention valves of each of the running compressor assemblies of the natural-gas compression station are closed."

4. Leading the operating points of the compressor assemblies in their characteristic maps toward the maximum efficiency line by varying the rotational speeds of the running compressor assemblies

The Examiner contends that FIG. 1 does not show a maximum efficiency line. As discussed above with respect to characteristic maps, one of ordinary skill in the art knows that a maximum efficiency line is a control line positioned to the right side of the pump protection line. Such a line is depicted in FIG. 1 as originally filed and would be easily identified by one skilled in the art as the line next to the pump protection line in FIG. 1. However, for clarity, Applicant submits a replacement sheet for FIG. 1 in which the maximum efficiency line is labeled.

In addition, the Examiner contends that it is unclear how the operating points in their characteristic maps are lead towards the maximum efficiency line. *See* page 6 of the Office Action. Further, the Examiner alleges that because various speed ratios are described as being run with respect to a characteristic map "to make clear how the operating points are lead to the efficiency lines one of ordinary skill would need to understand which variables can be changed." *See* page 7 of the Office Action.

However, Applicant submits that from the context, it is clear for one skilled in the art that after closing the surge protection valves only the rotational speed of the compressor assembly is varied in order to lead the operating points toward the maximum efficiency line. However, Applicant has amended claim 1 to include "leading the operating points of the compressor assemblies in their characteristic maps toward the maximum efficiency line <u>by varying the rotational speeds of the running compressor assemblies,</u>" in order to recite what was already implicitly claimed in claim 1.

5. Performing a reciprocal mutually coordinated variation of the rotational speed values

With respect to the feature of performing a reciprocal mutually coordinated variation of the rotational speed values, the Examiner contends that taken alone a "reciprocal mutually coordinated variation of the rotational speed" of the compressor assemblies is enabled by the specification as filed. *See* page 8 of the specification. However, the determination of desired values is allegedly not enabled because such a determination allegedly suggests a mathematical operation in a controller. *See* page 8 of the Office Action.

Applicant respectfully disagrees with the Examiner's position. FIG. 2B clearly shows an optimization computer arranged between the station controller and the individual rotational speed controller. As described in paragraph [020] of the specification as filed, "the rotational-speed desired values, before being transmitted to the rotational-speed controllers of the individual compressor assemblies, are trimmed by an optimization computer connected between the station controller and these individual rotational-speed controllers." In other words, based on FIG. 2B and the disclosure in paragraph [020], one of ordinary skill in the art would know that the determination of rotational-speed desired values is performed by an optimization computer. The mathematical operation performed in the optimization computer is described as a reciprocal mutually coordinated variation of the rotational-speed values of the compressor assemblies, which is, as admitted by the Examiner, enabled by the specification as filed.

In view of the above discussion, Applicant submits that the present application includes ample disclosure to assist those skilled in the art to make and use the invention, including implementing an appropriate method for optimizing the operation of a plurality of compressor assemblies of a natural-gas compressing station in the manner claimed.

Therefore, Applicant respectfully requests that the rejection of claims 1-6 under 35 U.S.C. § 112, first paragraph, be reconsidered and withdrawn.

III. Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the

Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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